

FULTON

A Study of
Concrete Mixers

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A STUDY OF CONCRETE MIXERS

BY

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THESIS FOR DEGREE OF BACHELOR OF SCIENCE
IN CIVIL ENGINEERING

COLLEGE OF ENGINEERING
UNIVERSITY OF ILLINOIS

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May 30 1902

THIS IS TO CERTIFY THAT THE THESIS PREPARED UNDER MY SUPERVISION BY

Robert Bruce Fulton

ENTITLED

A Study of Concrete Mixers

IS APPROVED BY ME AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE DEGREE

OF

Bachelor of Science in Civil Engineering

La. B. Baker

HEAD OF DEPARTMENT OF

Civil Engineering

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F95

During the past few years with the rapid increase of the use of concrete there has been much said about the quality and proportion of materials; but it seems to the writer that information as to the machines that do the mixing has been almost entirely neglected. In order that the type of machine best fitted for the work may be selected, the engineer or contractor should be conversant with the various forms on the market. The selection of a concrete mixer for any job will be largely governed by the volume of concrete required. On jobs requiring small quantities or even sometimes on jobs where large quantities are.



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necessary but which are distributed over considerable surface and consequently require many changes of location, it is often better not to use a concrete mixer; but for large contracts some form of mixing apparatus is usually more economical than hand mixing, since when the mass is large it pays to invest a comparatively large sum in the machinery to be employed. It seems to be the opinion of many that the quality of hand-mixed concrete is superior to machine mixed; but there is no doubt that under proper conditions and careful management a first-class machine will turn out a product as thoroughly or even better mixed than

that made by hand. In hand mixing it takes a vigilant eye to keep the men from using too much water and thereby reducing the strength, as the concrete is much more easily mixed when a little too wet. With a machine mixer the per cent of water is kept more nearly correct, as the amount of water does not effect the ease of mixing.

Whether mixed by hand or machine, the handling of concrete may be said to consist of three operations: measuring the batches; mixing; filling the conveyor and wheeling away.

It is the purpose of this article to describe the various styles of concrete mixers and also to show the relative capacities of the different machines.

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Concrete mixers are of two general classes: the batch mixers in which the charging and discharging alternate; the continuous mixers, in which the materials are fed continuously and from which the concrete is discharged in a steady stream.

In general there are five types of machines;

1. Gravity mixers in which the materials are thrown in at the top of the machine and fall by gravity through to the lower end.

2. Paddle mixers, consisting of a stationary oblong trough or cylinder with a curved bottom, and containing a revolving shaft, or shafts, with paddles or a screw upon it.

3. Oblong revolving boxes square in section and open

at both ends, the material⁵ being fed into one end and discharged by the inclination of the box from the other end.

4 Revolving cylinders or cones arranged with bafflers on the inside circumference to assist in mixing.

5 Cubical boxes suspended on two opposite corners the materials being mixed by the revolutions of the box.

Type I. GRAVITY MIXER.

Portable Concrete Gravity Mixer was invented by Frank B. Gilbreth and manufactured by the Contractors' Plant Company of Boston. It consists of a slanting tube or steel trough holding numerous rows of steel pins and deflectors, staggered in order to thoroughly mix the

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sand, cement and aggregate, as they gravitate through the tube. See Plate I. At the top is an iron hopper for receiving the material. The water is led from a barrel by a hose to the spray pipes. The man at the bottom of the mixer, who can see the concrete, operates the water valves and gates.

The water from the spray pipes strikes the material at about midway of the length of the shoot. By this arrangement the concrete is mixed dry in the upper half and wet in the lower half. The trough is made to vary from four feet to ten feet in length by adding sections. It can be seen that the ingredients in rolling over and over and being caromed back from the slanting pins and scattered from side to side

by each row of mixing pins,
is pretty thoroughly mixed,
particularly in its descent
through a ten foot trough.

The makers claim that the
stones are thrown into the
mortar with a greater force
than takes place in the
ordinary tumbling-box
style of machine, and that
therefore the particles are
coated better. Some tests made
at the Watertown Arsenal, of
concrete made by this machine
show greater strength than hand-
mixed concrete. Plate I shows
two views of the machine, the
arrangement of the staggered
pins, the deflecting plates,
and spray pipes. Plate 2 - Fig 1
shows the proper slant of
the mixer for the best
results. Plate 3 shows the
different lengths. Plates 4-12
show the manner of setting
up the machines under

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Different conditions. The advantages of this machine over other types are: no expense when idle; no steam, coal, oil, engine, boiler, hand power, and moving parts; and no skilled labor required. The Capacity is three hundred cubic yards per day.

Type 2. PADDLE MIXER.

This type of concrete mixer is a common form in which is required a volume of concrete ranging from seventy-five to one hundred and fifty cubic yards per day. The essential parts of this machine are a horizontal or slightly inclined trough containing a shaft which revolves about an axis parallel to its length, and which has attached to it paddles. The trough is sometimes open at the top, and sometimes closed. The open trough is most common

and is preferable because there is less danger of clogging, and if clogging does occur, it can be more easily remedied. Care must be used with an open machine, however, to see that the materials are thrown in so near to the upper end that they are thoroughly mixed before being discharged. The water is usually allowed to mix with the materials after they have run part way through the machine and thus have been first partially mixed dry. If the trough containing the mixer is a long one, it may be arranged, if desired, to mix the sand and cement into a paste before the gravel or broken stone is thrown in.

There are two distinct methods of operation which may be employed with a continuous mixer of the

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style described. The materials may be measured and spread in layers before shoveling in to the mixer, or they may be measured by shovelfuls as they enter the machine.

The best-known styles of paddle mixers are those made by the Drake Standard Machine Works, Chicago; Jeffrey Manufacturing Company, Columbus, Ohio; Thomas Caillat's Sons, Alleghany, Pennsylvania; Droguais Iron Works, Buffalo, New York; Cockburn Barrow and Machine Company, Jersey City, New York.

Drake Paddle Mixer.

The Drake Duplex No. 1 Concrete Mixer as shown in Plate 13 is twelve and one-half feet long by five and one-half feet wide and two feet two inches high. The frame is oak. The hopper has a double curved bottom

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to correspond with the radius
of the knives. The mixing
shafts are steel to which are
attached heavy cast semi-
steel knives for mixing and
also curved scoop knives
which turn the mixture
over. The curved knives act
not only as a scoop, but
also as a forwarding knife,
since in turning the mix-
ture over it is pushed for-
ward about four inches to
the next knife. There are
forty two straight knives and
sixteen scoop knives. The
capacity of this machine
is about four hundred cu-
bic yards per day, the small-
est sizes having a capacity
of twenty five cubic yards
per day. The weight of the
largest sizes is about fifty five
hundred pounds and the
power required to operate it
varies from fifteen to twenty horse

Sawyer. For railroad or large work the mixer is mounted on a flat car with an adjustable conveyor as shown in Plate 14. The stone, sand and cement are wheeled from the cars attached at the rear onto the platform and dumped from the wheel-borrows into a measuring box.

There are two boxes side by side, one being filled while the other is discharged,

thus insuring continuous feed. When filled with the proper proportions of stone, sand and cement the bottom reverses by pulling a lever, the materials fall into the mixer where after applying the necessary water it is mixed and forced by means of the mixing knives to the end and is deposited on the revolving conveyor. This conveyor delivers it to the desired place without

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being handled after it goes in-
to the measuring bases. It is
so made that it can be placed
in any position within a
half circle and can be raised
or lowered twenty-five feet.

Jeffrey Paddle Mixer

The Jeffrey Manufacturing
Company makes a paddle mixer
which consists of a screw
fourteen feet long and twelve
inches in diameter. The screw
is made of heavy cut steel,
flights mounted on two
and one half inch hollow
shaft with extra mixing
paddles every six inches. The
box is made of heavy oak
lumber thoroughly braced
and stayed and is lined
with ~~3/16~~^{3/8} inch steel. This ma-
chine is made also in
sixteen foot lengths. The
blue print, Plate 15, shows
the mixer mounted on a
movable truck or cart and

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drawn by a gas engine. The blue print, Plate 16, shows rear view of the complete machine encased to protect the engine against the weather, grit and dirt. The capacity of the fourteen foot or sixteen foot screw machine is from one hundred and fifty to two hundred cubic yards per day.

Iroquois Paddle Mixer.

The Iroquois Iron Works makes another style of the paddle mixer. In this machine the sand, cement, stone and water are all charged into the mixer at the same time and are retained there until thoroughly mixed. The mixing is effected by oblique blades or teeth on two horizontal parallel shafts which revolve in opposite directions, thus constantly working the material

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from all sides to the center
from which it is discharged
by a slide in the bottom.
The blades are rounded off
to a blunt point so that as
they sweep around the
lining of the machine a
stone can not wedge be-
tween the end of the blade
and the side of the machine,
since the blunt point knocks
the stone away. The sides
and bottom of the machine
are made of steel plate and
the heads of cast iron strong-
ly ribbed. The shafts are of
steel, square cross section, and
as the teeth are fastened on
them by bolts clamping
around the shaft, the
full strength of the latter
is maintained. The teeth
are made of chilled charcoal
iron, which is very tough
and hard. See Plate 17.

This machine is made

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in sizes having capacities of from seven cubic yards to twenty cubic yards per hour. Its most objectionable feature is the amount of power required to run it, about thirty-five horse-power.

Carlin's Paddle Mixer.

This mixer is designed to meet special demands for a compact, low-priced means of making and placing concrete in fire proof buildings. The mixer proper consists of a steel and iron trough with a steel shaft revolving in its center to which is attached suitable knives arranged so as to be easily removed. See Figure, Plate 18. The mixer is driven by a vertical engine by means of spur gearing. The friction drum hoist is driven from the same engine and gearing, but the mixer

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can be easily disconnected when desired. The hoist is complete in itself, being fitted with foot brake with ratchet and pulley, and is used for hoisting and distributing the concrete on the various floors of the building.

Type 3. OBLONG REVOLVING BOX MIXERS.

The third type of concrete mixer is the oblong revolving box which is somewhat similar in operation to the paddle mixer. The best known is perhaps that manufactured by the Cockburn Barrow and Machine Company, Jersey City, New Jersey. As shown in Plate 20 it consists of a square tube set on an incline with a hopper at the upper end in which to throw the materials. The principal mixing is done by the revolu-

18
tions of the box and the concrete is discharged from the lower end into wheelbarrows or other vehicles. The mixer is sometimes directly connected with the engine furnishing the power and, sometimes belted. This machine is sometimes used as a batch-mixer, the raw materials all being dropped into a hopper above and let down into a machine through a trap door. However concrete made in large batches with this particular machine is not so thoroughly mixed as when the machine is used as a continuous mixer, that is, when the material is shovelled in continuously and falls out at the end in a continuous stream. The capacity of this machine is three hundred cubic yards per day of ten hours.

Type 4. REVOLVING CYLINDER MIXER.

One of the most common styles of machines of this type is the Ransome Mixer made by the Ransome and Smith Company of Brooklyn, New York. It consists essentially of a hollow rotating iron and steel drum having openings at the center of its head.

Within are kneading wings for mixing, and hinged shelves by which the concrete is lifted and thrown in to the discharging chute.

These shelves are set for mixing or discharging by the movement of a lever, without stopping the machine. The drum is carried upon four friction rollers, the bearings of which are supported upon the frame of a truck. The truck consists of a stout wooden frame, steel axles, wrought-

iron wheels, a fifth wheel and a pole. Passing through the drum and supported upon the truck is a folding chute, which receives the concrete from the drum and delivers it to the wheel barrows or other receptacles used for conveying it away. Plate 21 and 22.

McKelvey Revolving Cylinder Mixer.

The McKelvey Concrete Machinery Company of Chicago, manufacture a machine with revolving cylinders which may be operated either by hand or by a small gasoline engine. The machine consists of a cylindrical drum revolving sufficiently to work the materials to the outlet end after it is mixed. Attached to the inside surface of the drum are a number of blades set at an angle with the diameter, and

also two hinged steel plates extending the length of the drum. This drum is supported by two wheels for easy transportation. The materials are shoveled into one end, turned in the ordinary machine eight times and issue from the other end thoroughly and evenly mixed.

The machine is made in all sizes for machine and hand power. The ordinary size requires four men to operate it—two men to turn the drum and two for putting in the ingredients. The capacity varies with the size and runs from five to twenty cubic yards per hour. The machine may be used on large or small jobs, stationary work or when constant moving is required. Plate 23

Smith Concrete Mixer.

The machine consists of a drum of double conical form supported and guided by a frame, which can be tilted at will, while the drum is revolving. The materials to be mixed are fed in at one end of the drum, and are discharged at the other end by tilting the drum while running at full speed. The interior of the drum is provided with rigid blades, arranged in sets as shown in Figure 24 each set of blades forming a shingled spiral. The alternate sets are of reversed winding, and overlap each other in the middle of the drum. The drum consists of a central ring - a single casting - to which is riveted the steel funnel shaped ends. This central ring is provided with gear

teeth for driving and machine surfaces for guiding the drums. Its central location places the moving parts as far as possible from both the dust and wet material, which makes a natural protection. The weight carrying rollers are under the drum at its middle. The side guiding rollers have very little to do by reason of the drum being balanced on the supporting rollers underneath. The driving gearing is placed in a box which covers it as far as practicable, and is further protected by the direction of motion being such as to allow the material to fall out before being caught by the teeth before coming into mesh. The swinging frame is made of steel riveted up like a bridge and properly braced.

It is supported on an axis so placed that the drum tilts as easily when full as when empty. A counterbalance, consisting of a fan with oblong weights, is provided so that the effort of tilting can be regulated. When the counterbalance is properly adjusted, one man can tilt the drum whether empty or full, and return it the mixing position. The machine is mounted on a substantial truck with steel wheels. On the same truck can be readily placed a steam engine and boiler, or gasoline engine, or electric motor. The machine is made in three sizes. The smallest size - No. 1 - is intended to mix a batch of any ordinary proportions, based on a single bag of

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Portland Cement. The No 2 size is intended to use two bags of cement in a batch, and the No 3 size is intended to use a barrel of cement in a batch. The standard charges of the three machines are nine, thirteen and one half, and twenty eight cubic feet. The capacities are ten, fifteen and thirty cubic yards per hour respectively.

Dromedary Mixer.

A recent style of concrete mixer is the Dromedary Mixer. A view of the mixer ready to load is shown in Figures 25, 26. As soon as the materials are thrown into the drum, which is geared to the wheels so that it turns when the cart moves mixes the concrete. The wheels are loose on the axle so that they may

revolve independently in turning from a straight course.

They have a pawl and ratchet connection with the drum which is easily thrown in and out of gear, and in the ordinary course of things these changes are for the most part attended to automatically by the mechanism. For loading, the drum is provided with a hinged trap door, which is seen open in Figure in which position brackets on the door rest on the Tail Bar, and the drum is steadied in the position shown. As the drum goes automatically out of gear when the trap door is wide open, the mixer can be moved about freely when loading. The trap door hangs conveniently low when the drum is empty

and as the loading proceeds, the door gradually rises so that the drum may be nearly or quite filled without risk of spilling any of the contents. On the way to the dumping place the drum revolves with the wheels, and a very moderate haul suffices for mixing the concrete thoroughly. There is no pitching about of the contents of the drum in this operation, the materials being simply carried up a little way with the climbing side of the revolving cylinder, curl over and slide down in successive thin sheets towards the front, throwing the stones well into the mortar. At the dumping place throwing the unlatching bar towards the drum opens the latch and

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dumps the mixer as shown in Figure. The drum automatically goes out of a gear at the very end of a dumping movement, so that the mixer can deliver its load and move on out of the way without stopping. The drum is closed by a pull on "full-back-plates" or hand-holes conveniently located for the purpose. In closing, it automatically locks itself out of gear and so travels back "light running" to the loading place.

The kind of work for which the Dromedary Mixer is best suited is for street-railway work, curb-setting, cement sidewalks, pavement foundations or other street work where it can be easily moved about. The mixing platforms and wheel-

barracks are displaced with and the number of men reduced. The daily output is from twenty-five to thirty-five cubic yards of concrete measured after it is in place according to the conditions and management under which it works.

Type 5. CUBICAL BOX MIXER.

The last type of concrete mixer is the cubical box, Plate 27. It is manufactured by the same parties who make the paddle mixers and is made in small sizes to be operated by hand power, but it is mostly used on contract work where a large mass of concrete is to be deposited. This mixer consists simply of a cubical box, wood or iron, with a hinged door at one corner. A shaft runs through two opposite corners to furnish the power

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for revolving it, and a perforated hollow tube surrounds this shaft for supplying the water to the mixer. The shaft is generally geared to a small counter-shaft, which in turn is connected by a clutch pulley with the driving engine, the mixing being done by the revolving of the box. The usual practice for handling the material is to mount the mixer upon a timber frame with one or more hoppers above for receiving the raw materials, head room underneath for cars or carts to receive the milled concrete. The engine for driving the mixer may be located either on a level with the machine or on the ground. The design and construction of the machinery for handling and measuring

the materials before they enter the mixer depends entirely upon the local conditions and the quality of concrete to be made.

Where the mass is large it is often economical to employ expensive apparatus for this purpose.

The usual sizes are four feet and five feet on an edge the nominal capacity for the small size being one cubic yard per batch and for the larger size two cubic yards to a batch each measured after concrete is in place.

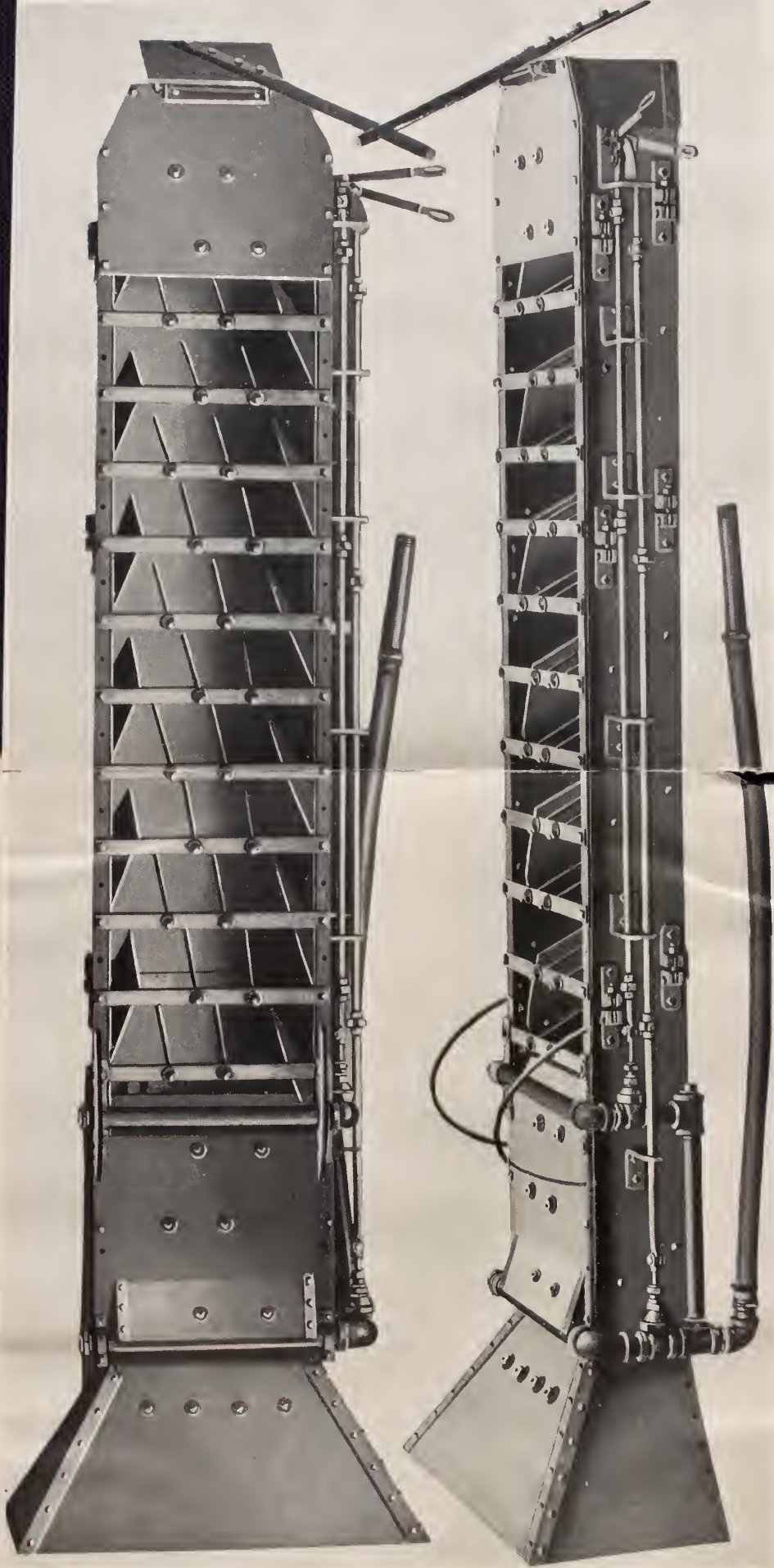
Reference to the quality of concrete made under different conditions is necessarily omitted as a comparison of the work turned out by the different styles would be of value only through the conducting of a series

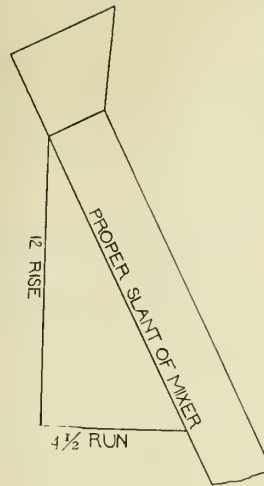
of comparative tests under identical conditions. The handling of the materials before they enter the mixer, and the methods of disposing of the concrete after it is mixed effects the quality as much as the actual mixing proper.

A good machine can always be made to produce poor concrete, if it not properly run in the same way that hand made concrete can be made very poor. With any continuous mixture if absolutely uniform results are to be obtained, it is necessary to see that each series of shovel fulls which enter the mixer shall contain approximately the proper proportions of ingredients. On this account the batch mixers, as a rule, require less inspection than

mixers which are fed continuously. One of the most necessary requirements with all kinds of machine mixing is the proper regulation of the water supply. It is impossible under conditions which usually occur in practice to lay down the law that a given quantity of water is to be used for each batch of materials. The moisture contained in the sand, the kind of cement used, the condition of the mass where the new concrete is to be deposited - whether dry or wet - and other circumstances effect the amount of water to be used.







CUT S

THE PROPER SLANT OF MIXER FOR BEST RESULTS

For Cinder Concrete,	about 4"	run to 12" rise.
" Broken Stone Concrete,	" 4 1/2"	" 12" "
" Gravel Concrete,	" 5"	" 12" "

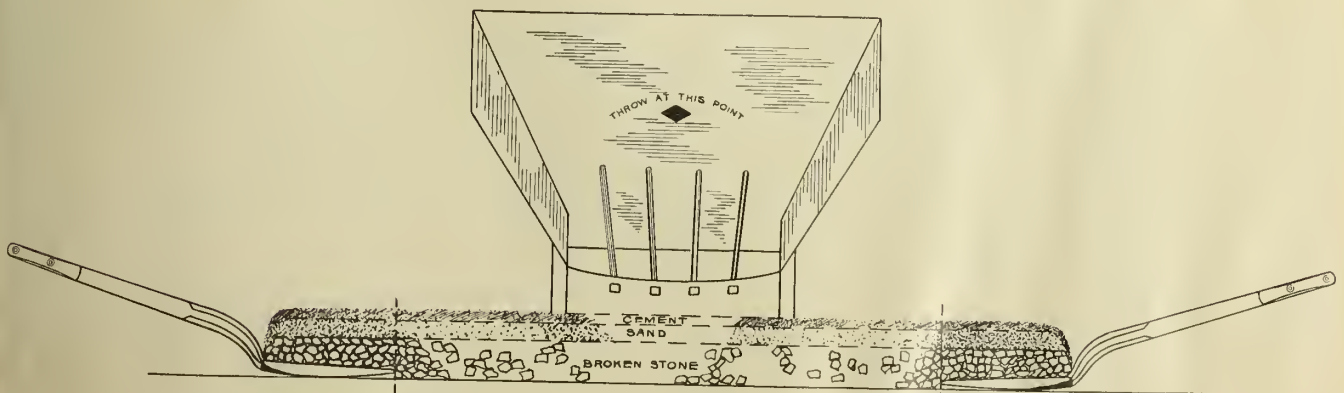
DIRECTIONS FOR MEASURING A BATCH OF CONCRETE

Measure the broken stone and spread evenly about 6" thick.

" " sand " " " on top of stone.

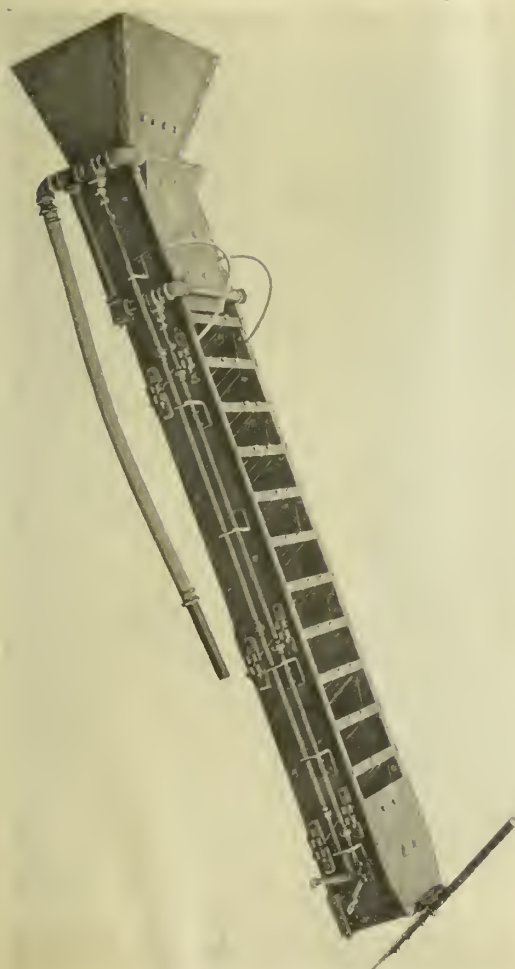
" " cement " " " " " sand.

SHOVEL INTO MIXER WITHOUT ANY DRY MIXING OR FURTHER PREPARATION

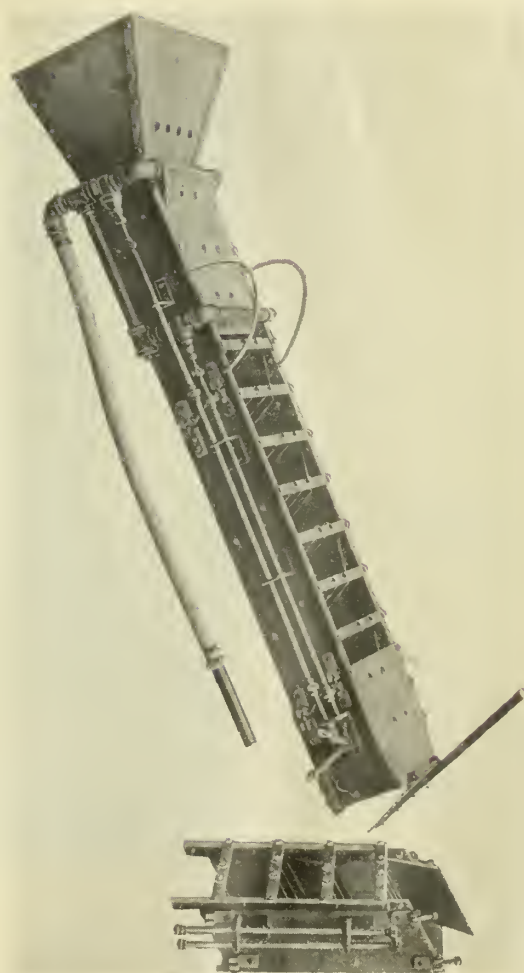


CUT B X

MO

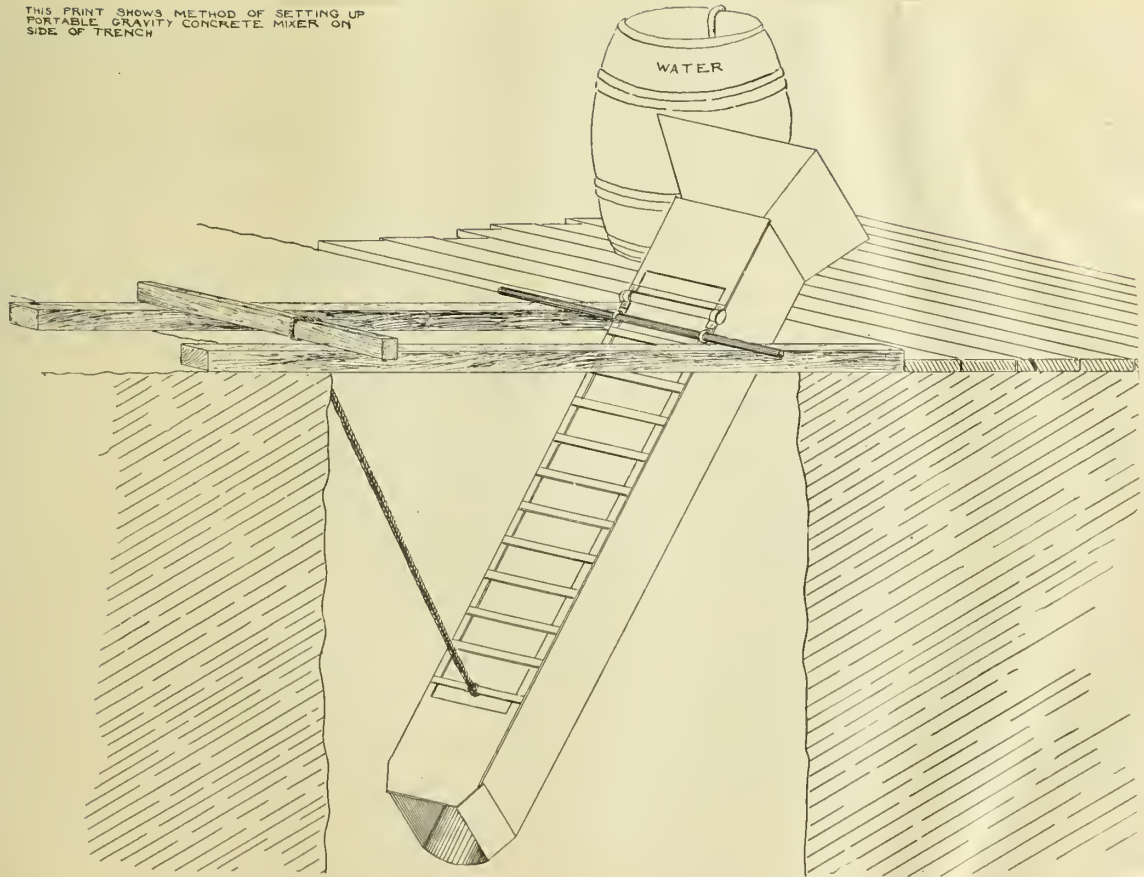


CUT FO
LENGTH, TEN FEET (ALL SECTIONS ASSEMBLED)



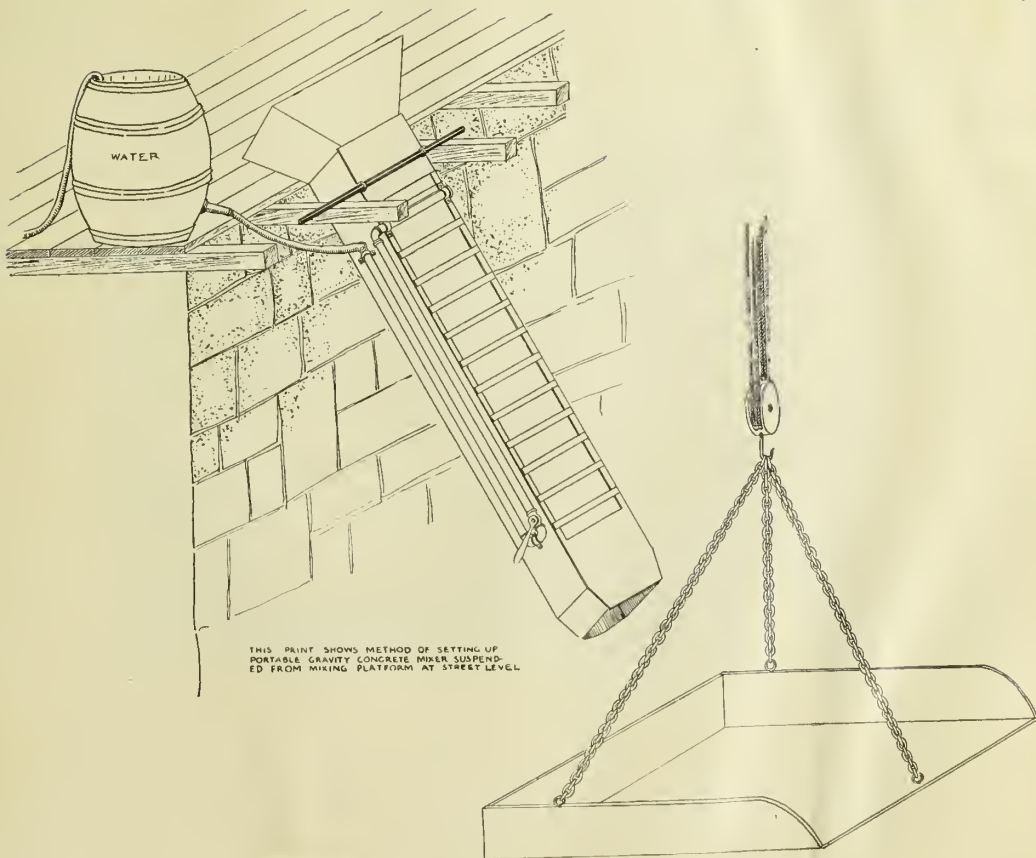
CUT FP
LENGTH, EIGHT FEET (SHORT SECTION OUT)

THIS PRINT SHOWS METHOD OF SETTING UP
PORTABLE GRAVITY CONCRETE MIXER ON
SIDE OF TRENCH



CUT Q

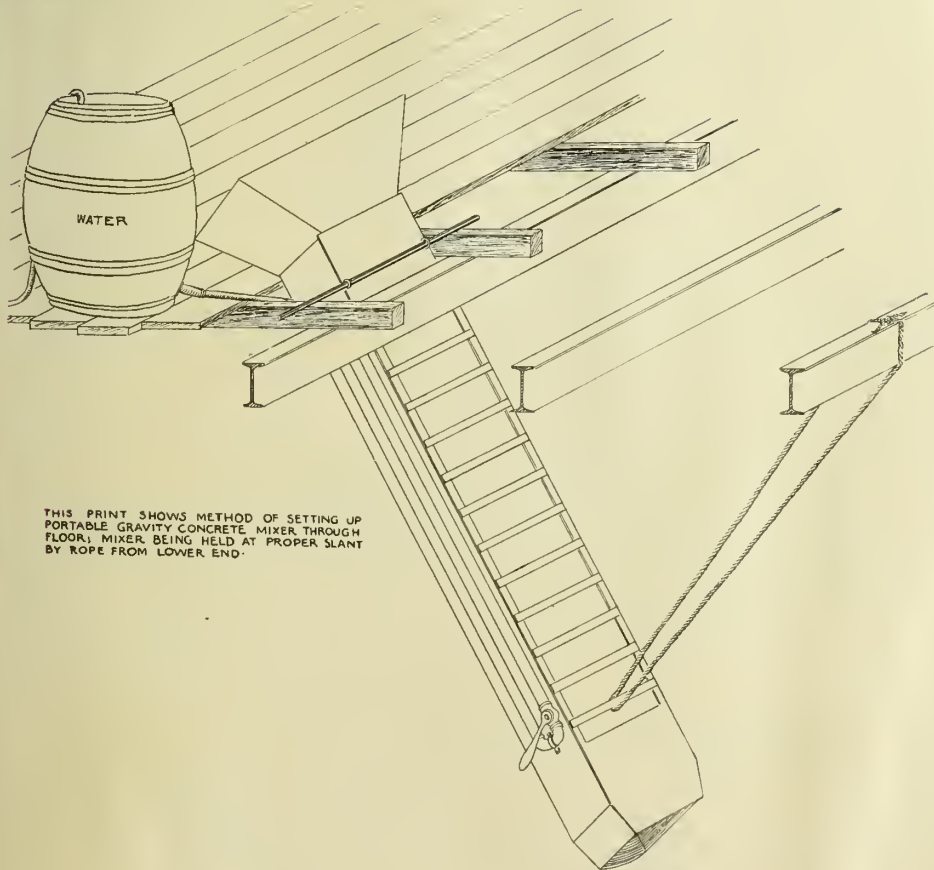
METHOD



THIS PRINT SHOWS METHOD OF SETTING UP
PORTABLE GRAVITY CONCRETE MIXER SUSPEND-
ED FROM MIXING PLATFORM AT STREET LEVEL

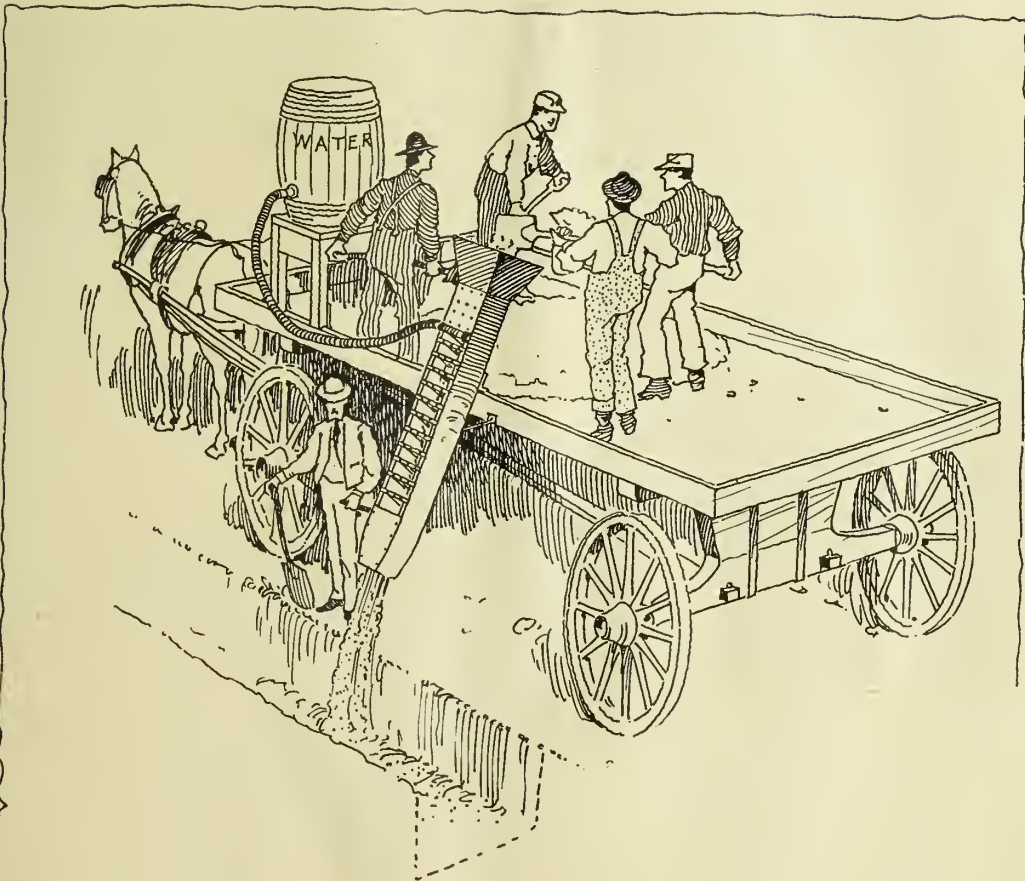
P MIXER

LXVII

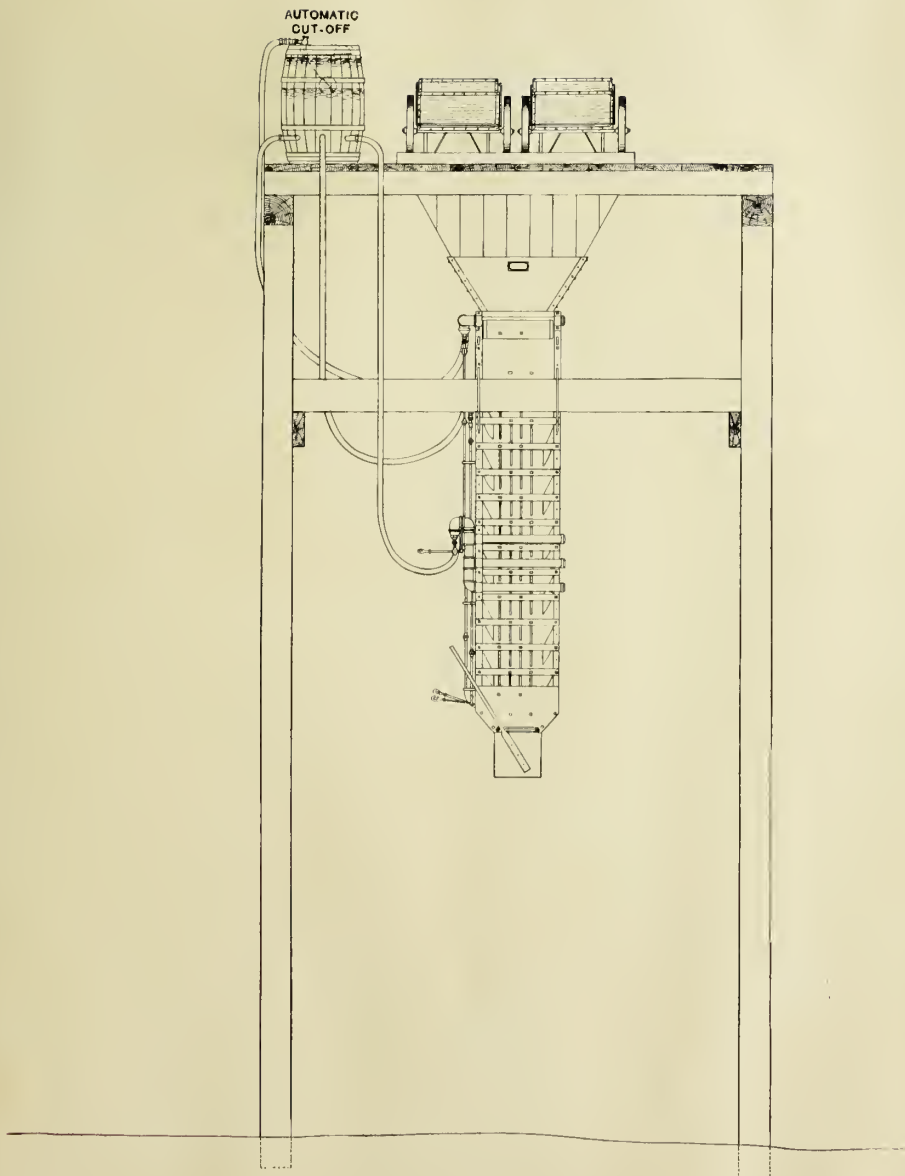


THIS PRINT SHOWS METHOD OF SETTING UP
PORTABLE GRAVITY CONCRETE MIXER THROUGH
FLOOR; MIXER BEING HELD AT PROPER SLANT
BY ROPE FROM LOWER END.

CUT O



CUT M





CUT E V

ENTERED ACCORDING TO ACT OF CONGRESS, IN THE YEAR 1901, BY CONTRACTORS PLANT CO., IN THE OFFICE OF LIBRARIAN



The above picture shows the **PORTABLE GRAVITY CONCRETE MIXER** mixing a batch of 35 cubic feet in less than $\frac{1}{2}$ a minute—the time being taken by two men on top of the platform.

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CUT B S

EIGHT FT. LENGTH



CUT J

View of street floor.

The Gravity Mixer as used on Y. M. C. A. Swimming Tank, Salem, Mass.

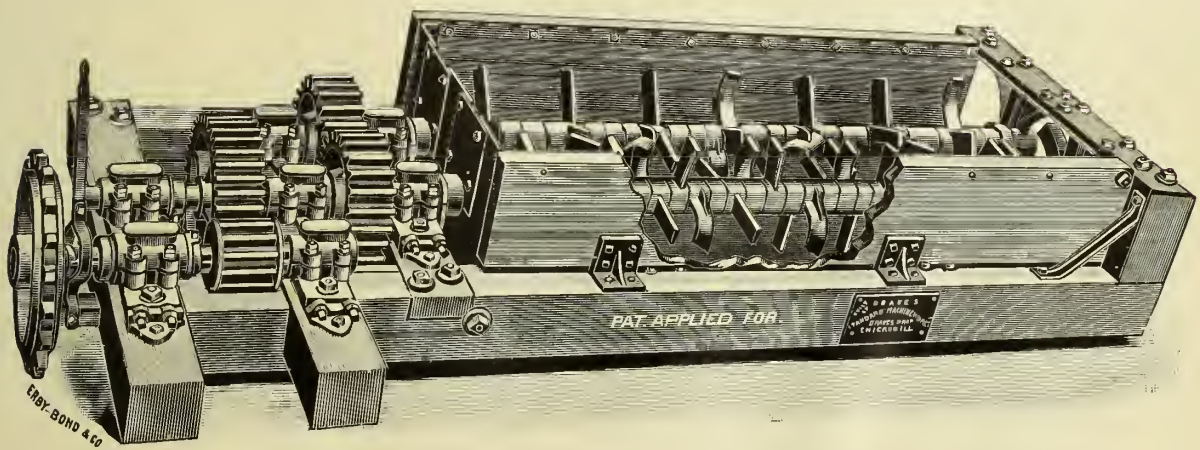


CUT L

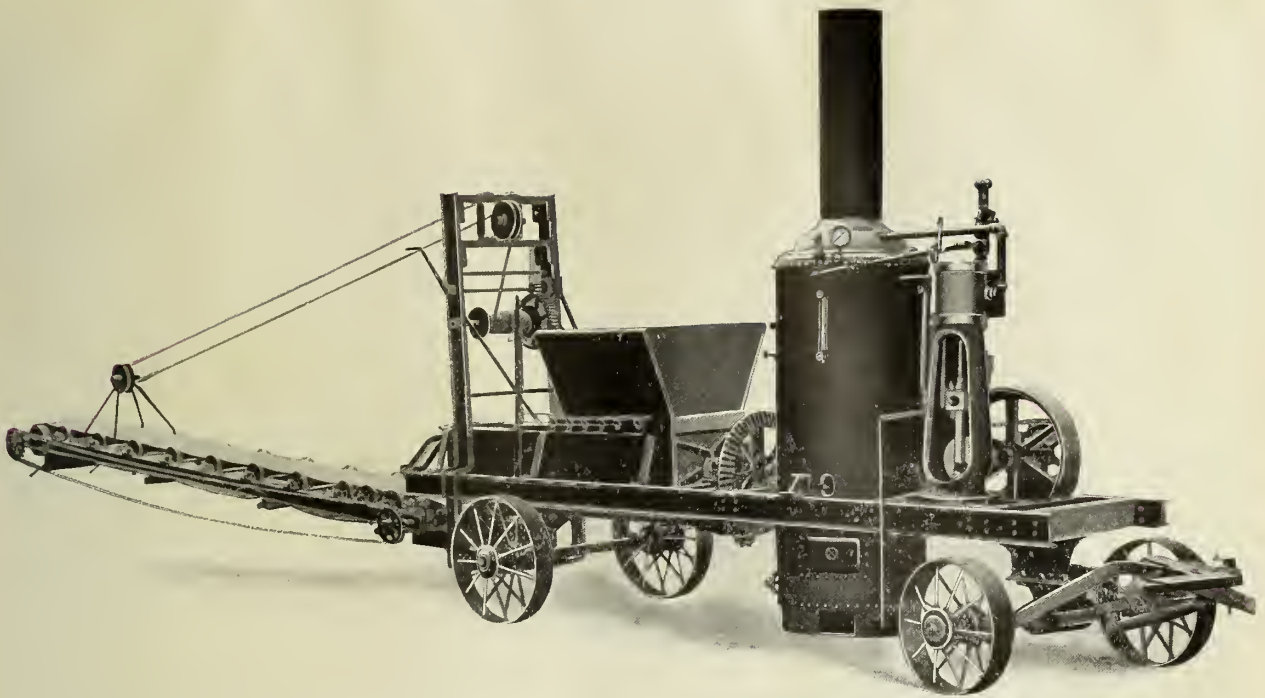
View of basement.

TEN FT. LENGTH.

CONCRETE MIXER.

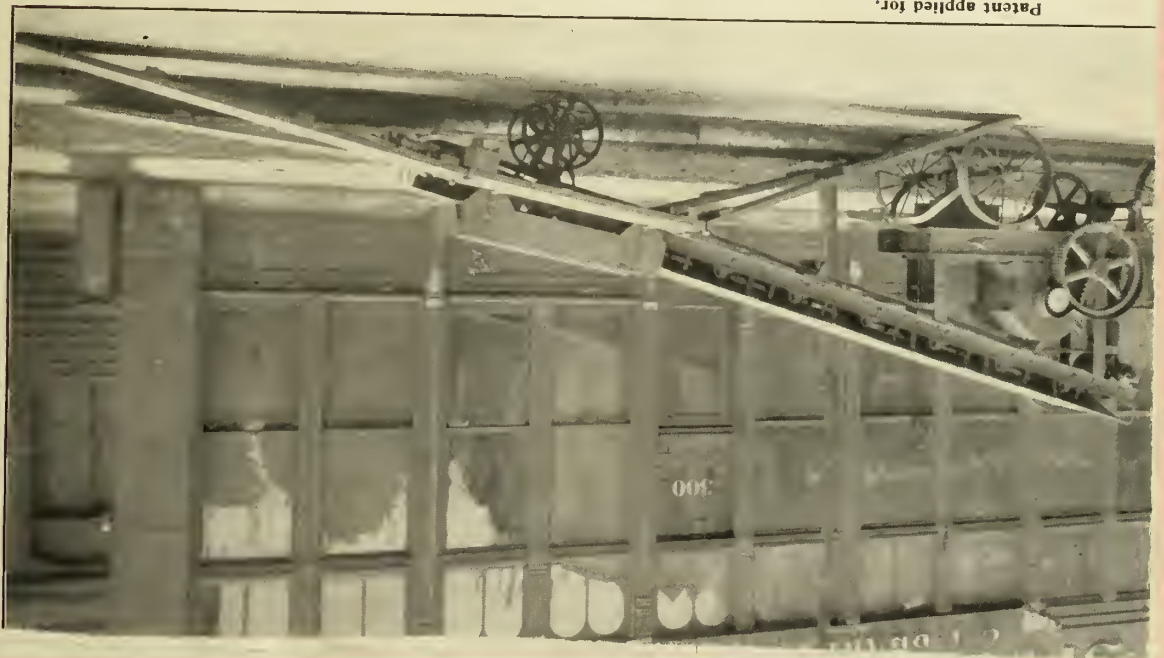


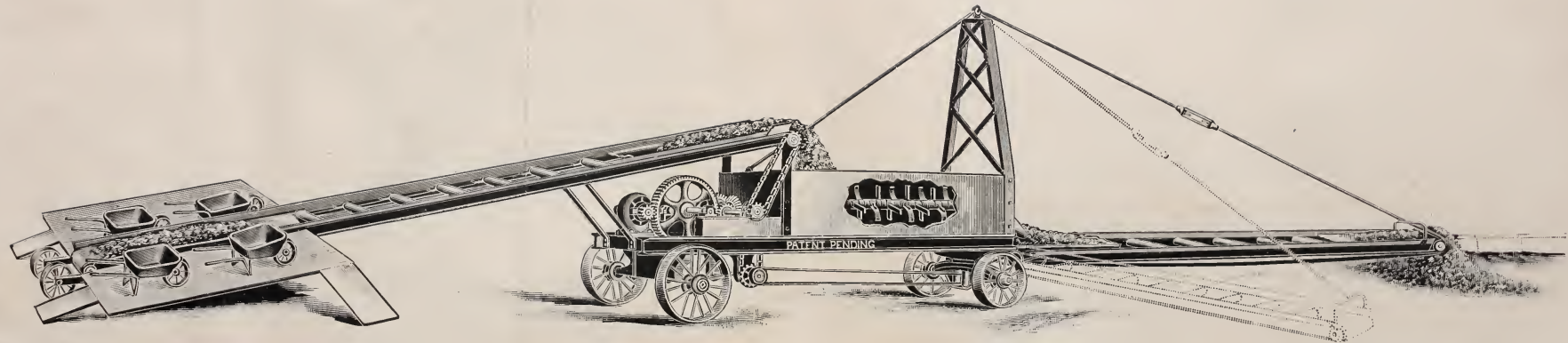
DUPLEX No. 1.



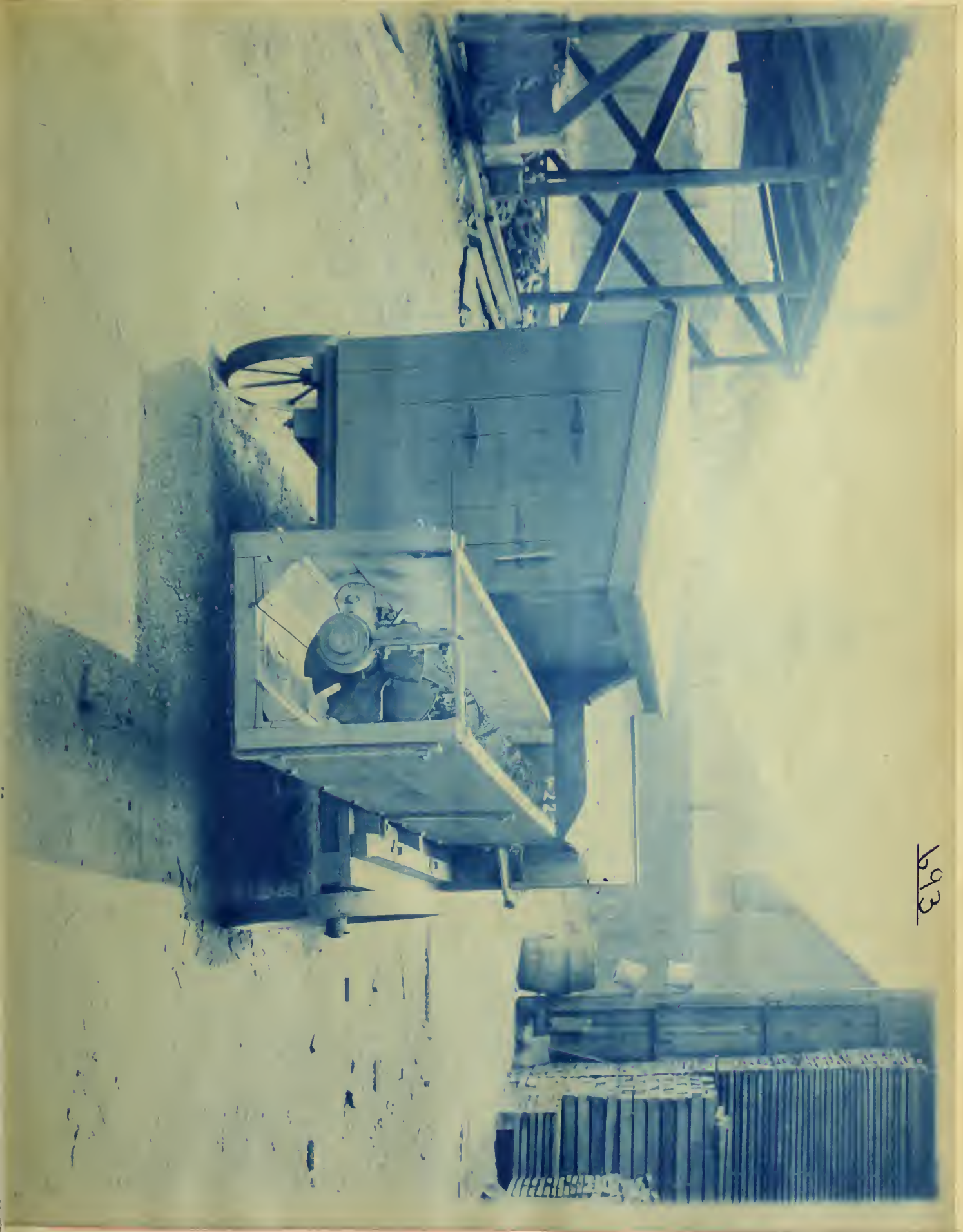
PORTABLE CONCRETE MIXER WITH, DELIVERY CONVEYOR AND MEASURING BOX

Patent applied for.
it to the Cambria Steel Company, Philadelphia, Pa.



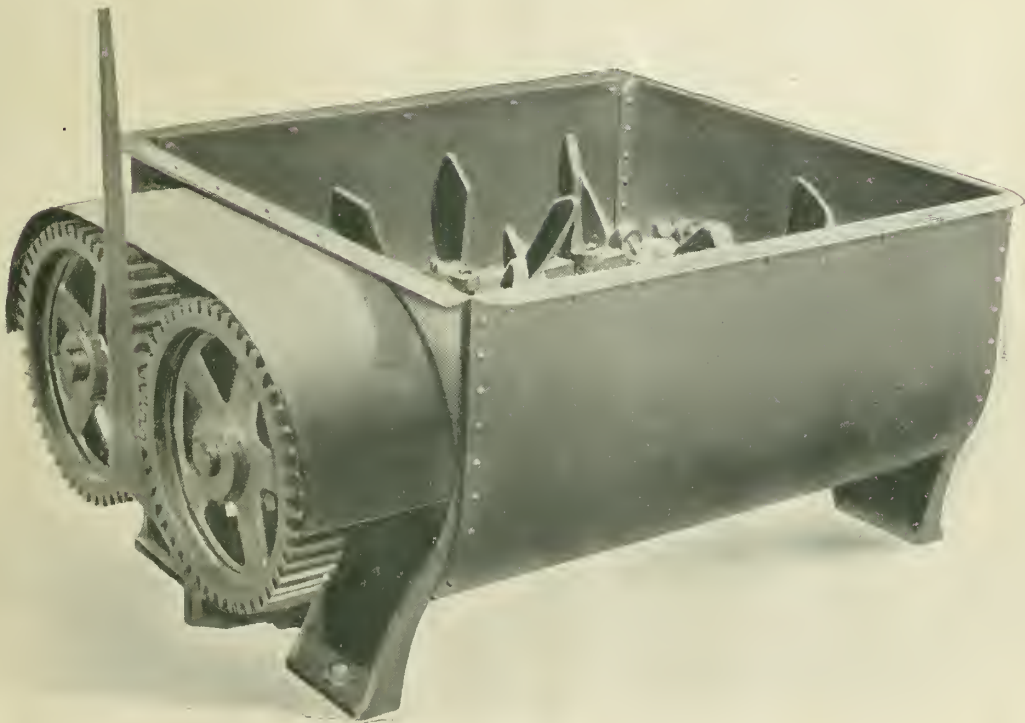




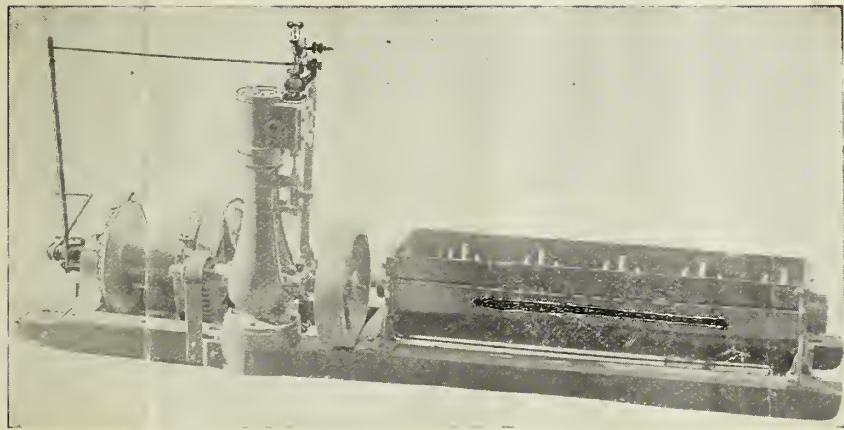


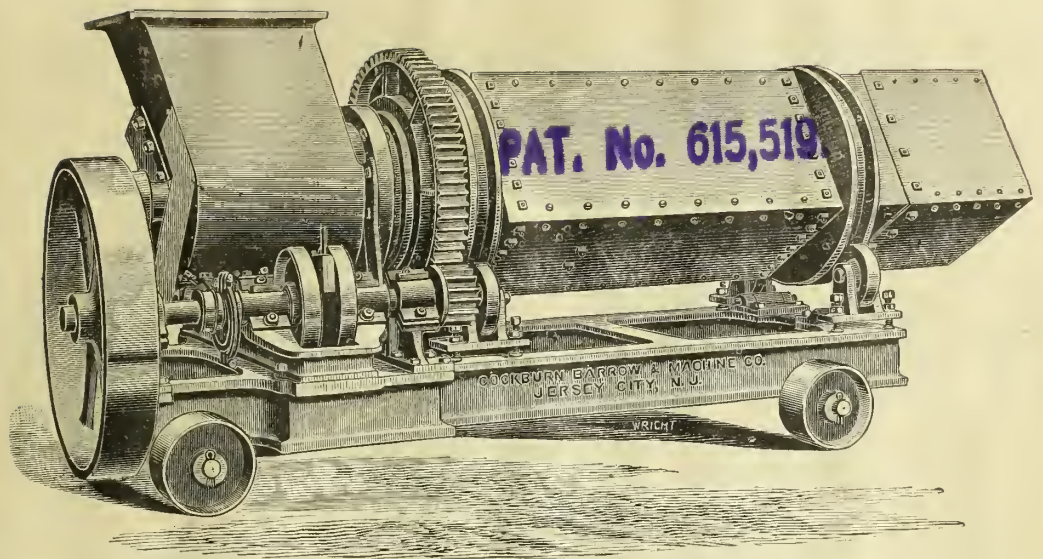
188



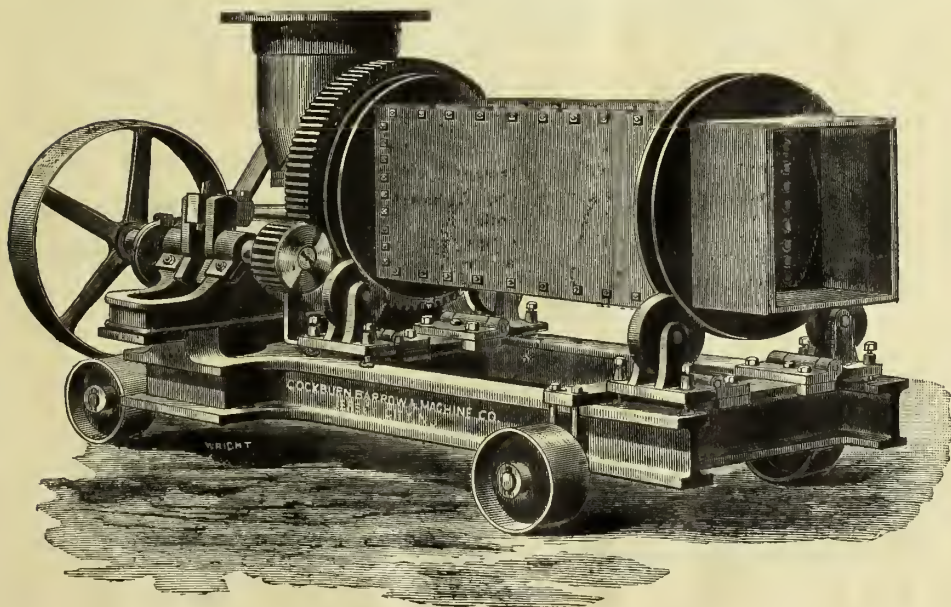


CONCRETE MIXER. CAPACITY, 1 CUBIC YARD

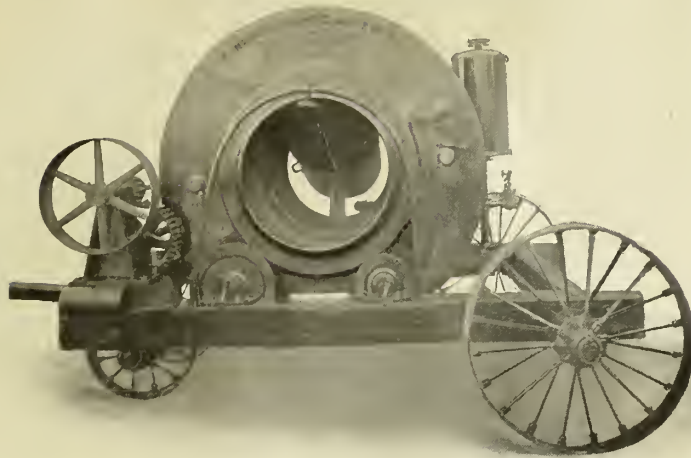




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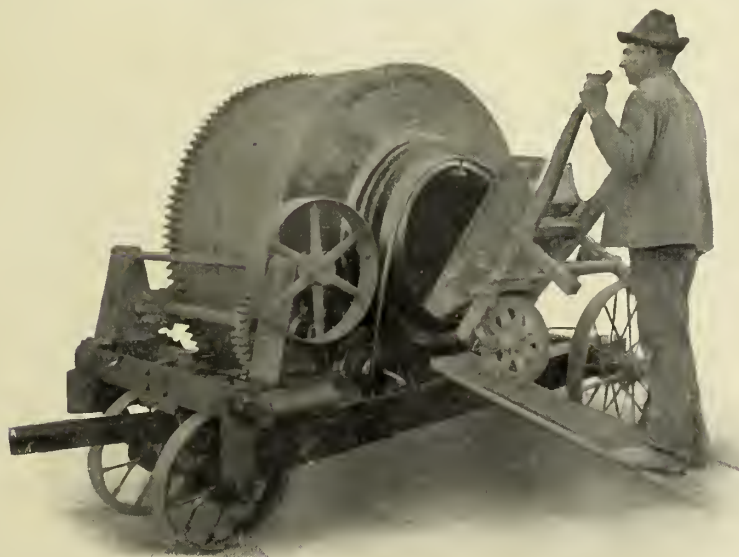


DRUM MIXER.



RECEIVING SIDE.

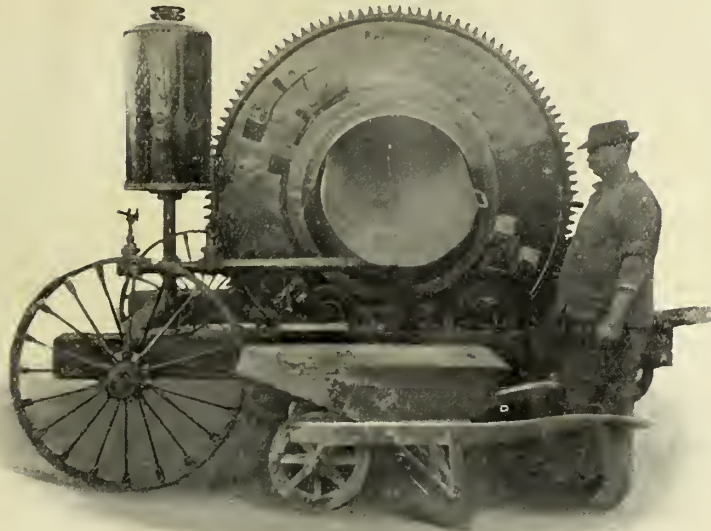
DRUM MIXER.



CHARGING.

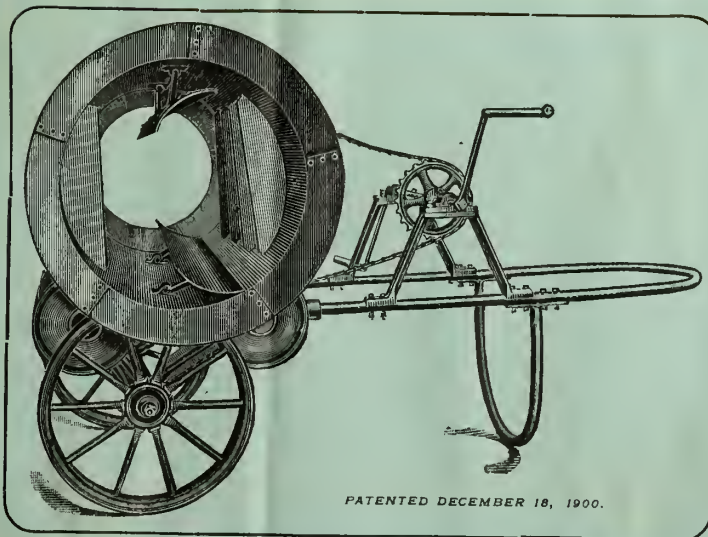
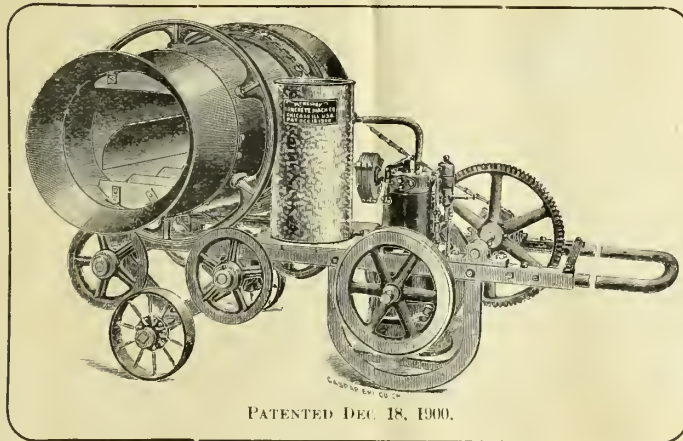
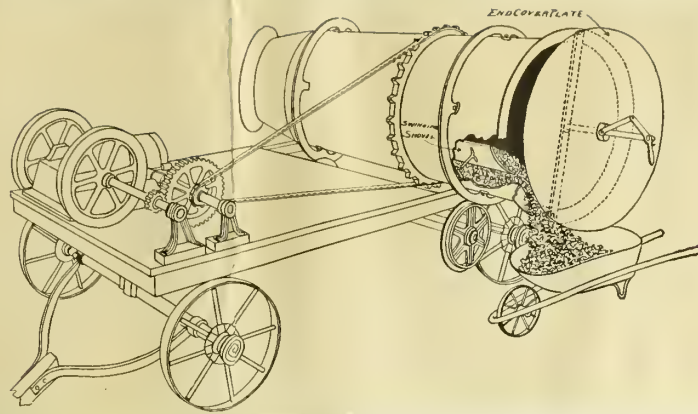
NO ELEVATING OF MATERIAL.

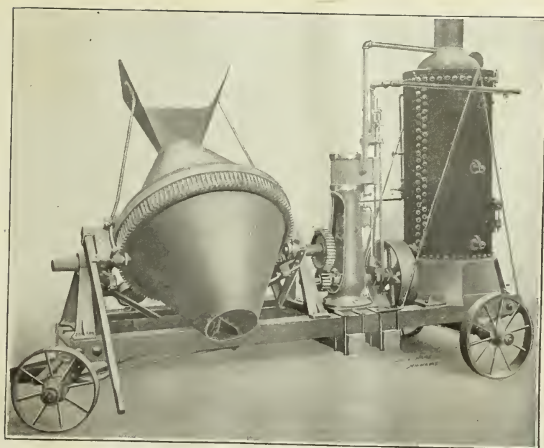
DRUM MIXER.



DELIVERY SIDE.







DISCHARGING POSITION.

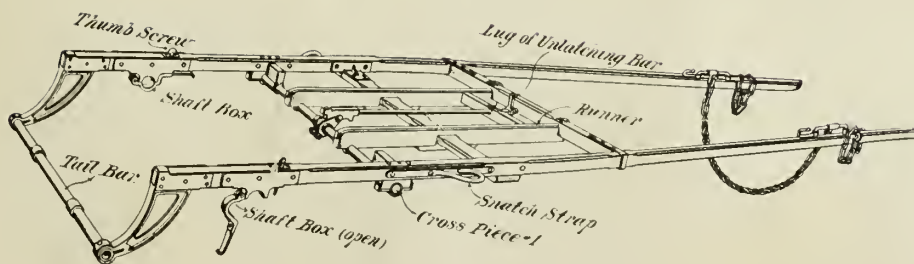


Fig. 9



I—READY TO LOAD



II—LOADED



III—DUMPING



IV—DUMPED



V—CLOSING

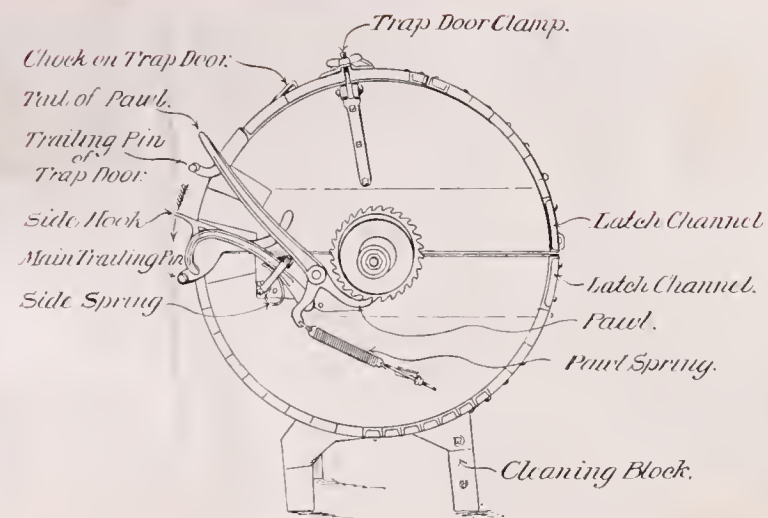


Fig. 7

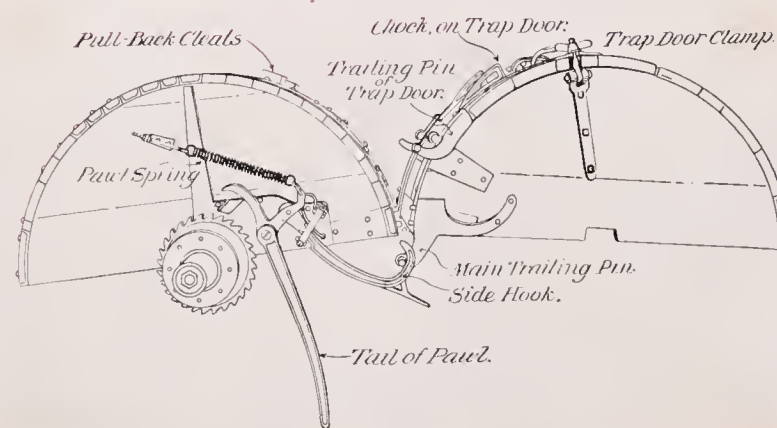


Fig. 8

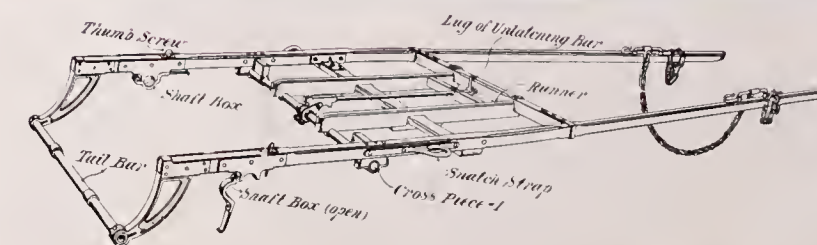


Fig. 9

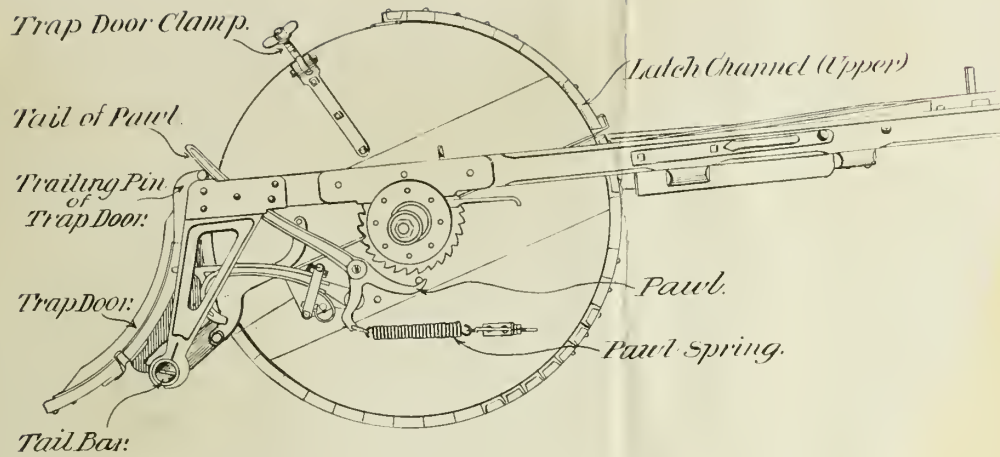


Fig. 6

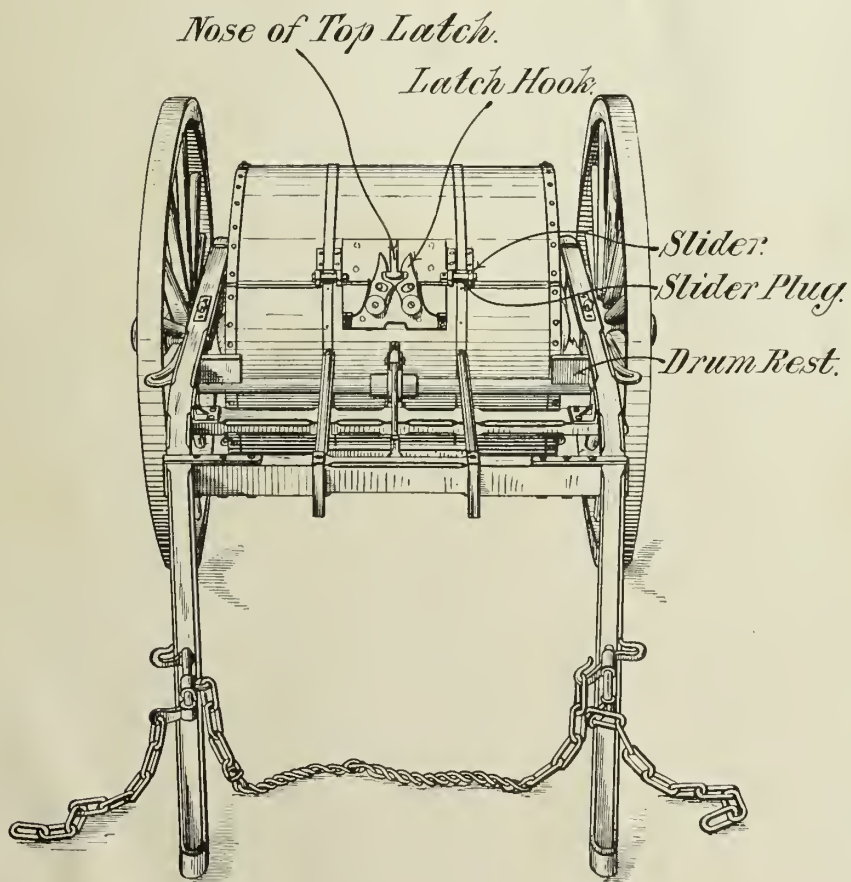
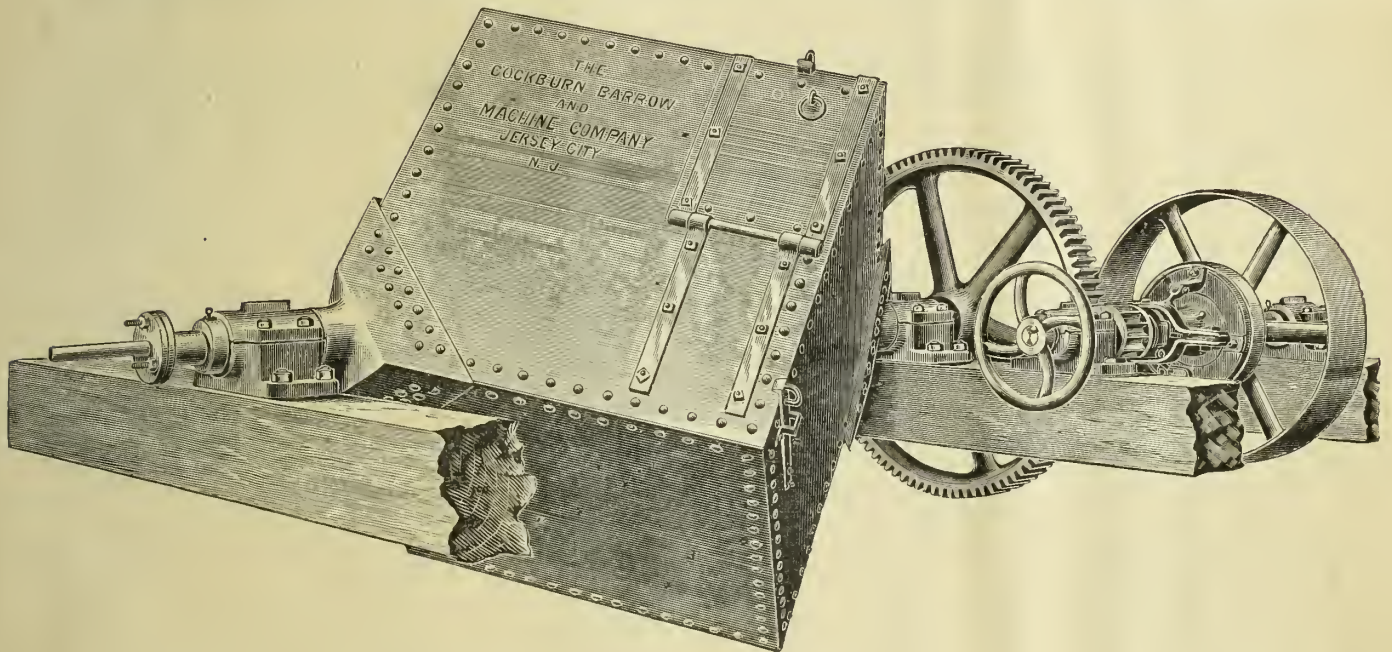


Fig. 10

SQUARE TUMBLING BOX CONCRETE MIXER.



NO. C.





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